SPECIFICATION

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[STAPLE-FORMER IN A STAPLER]

Cross Reference to Related Applications

The present application claims priority to Swedish Patent Application No. 0103048-5 filed 14 September 2001. Said application is expressly incorporated herein by reference in its entirety.

Background of Invention

[0001]

TECHNICAL FIELD. The present invention relates to a staple-former in a stapler in which staples are driven by a driver blade into a workpiece, preferably a sheaf of paper. The stapler contains a staple magazine in which longitudinally extended staple blanks are stored. The staple blanks are advanced onto an integral bending die by a feed device contained in the stapler. The bending die has an upper support surface over which the staple blanks are bent by a staple-former into staple shape. This staple shape includes a first and a second leg with an intermediate crown portion. The staple-former has a first leg-bending part and a second leg-bending part with an intermediate crown-forming part that exhibits a stamping surface. The formation of a staple is accomplished by the staple-former being driven by a drive device that is integrated into the stapler from an starting position in a staple-forming motion in a direction that is transverse to the direction of extent of the support surface. During this motion, the staple-former is brought against the bending die, whereupon the leg-bending parts over the bending die bend the staple blank into a staple shape. In a continuation of this motion, the staple-former is advanced a distance such that the stamping surface of the crown-forming part presses the crown portion of the staple blank against the support surface. After this, the staple-former is reciprocated by the drive device back the starting position and the bent staple that has been formed is fed

forward to the driver blade .

[0002] BACKGROUND OF THE INVENTION: Staple-formers of the type described above are generally known. Such a staple-former is exemplarily described in the Swedish patent application SE 9201230-1. A disadvantage of earlier staple-formers is that they require extremely precise regulation of the staple-forming motion, since it is very important that the staple-former undergo reciprocation within an extremely narrow tolerance range. If reciprocation occurs too early, the crown-forming part will not press the staple crown against the bending die, and the staple blank will not be bent sufficiently and this often causes the stapler to jam. If reciprocation occurs too late, the crown-forming part will strike the bending die with great force, which damages the staple while at the same time causing the staple-former and drive device to wear much more rapidly. To counteract the aforesaid disadvantages, solutions have previously been proposed in which the stapler is equipped with damping devices that damp the staple-forming motion before reciprocation occurs. These devices are often complicated and expensive to fabricate, and they fail to solve the problems that arise when reciprocation occurs too early.

[0003] Another disadvantage of existing staple-formers is that, since they are usually driven by the same drive device that drives the driver blade, the staple-former must be adjusted precisely in relation to the driver blade, which can often be an extremely difficult task to perform.

[0004]

The present invention overcomes these disadvantages by means of a staple-former of a type in which the crown-forming part is displaceably connected to the staple-former by means of an intermediate biasing means, also referred to as an elastic element and/or a take-up device or means. In a preferred embodiment, the elastic element takes the form of a leaf spring bent into a hairpin shape. Further in this preferred embodiment, the crown-forming part is displaceably connected to the staple-former by means of a guide arrangement. Still further, the staple-former exhibits an integrated driver blade. The biasing means or elastic element is configured or selected so that the biasing force exerted thereby is sufficiently high to maintain the crown-forming part in an extended position through out the bending of a staple blank over the bending die, but also sufficiently weak to permit the crown-forming

part to retract into the body of the staple-former when the staple bending process has been completed, but the staple-former continues to be driven toward the bending die.

Brief Description of Drawings

[0005] The invention will be described below with reference to the accompanying figures, in which:

[0006] Figure 1 is a schematic view, shown in partial cut-away, of a stapler according to the present invention;

[0007] Figure 2 is an elevational view of a staple blank bent into staple shape;

[0008] Figure 3 is a perspective view showing the staple-former and bending die of the invention, and on which an unbent staple blank is placed;

[0009] Figure 4 is a side elevational view corresponding to Figure 3;

[0010] Figure 5 is a cross-section view taken along the line A-A shown in Figure 3;

[0011] Figure 6 is a perspective view corresponding to Figure 3, in which bending of the staple blank has begun;

[0012] Figure 7 is a perspective view corresponding to Figure 3, but in which the staple-former has been moved an additional distance relative to Figure 6;

[0013] Figure 8 is a perspective view showing s the staple-former in the position in which the staple blank has been fully bent; and

[0014] Figure 9 is a side elevational view of the arrangement shown in Figure 8.

Detailed Description

[0015]

A preferred embodiment of the invention will hereinafter be described with reference to the accompanying drawings. In that regard, Figure 1 shows a stapler arrangement 1 that includes a base part 2 to which a stapler head 3 is pivotably connected by means of a pivot shaft 4. The base part 2 is equipped with a staple anvil 5 and a feed device 6. A staple magazine 7 is arranged in the stapler head 3 and contains longitudinally extended staple blanks 8 whose long sides are joined to one

another to form an extended band that is arranged into a roll shape 9 in the illustrated embodiment. In the stapler head there is arranged a driver blade 10, which is integrated with a staple-former 11, also referred to as a staple forming arrangement 11.

[0016] The staple-former 11 is interconnected with drive arms 12, but only one of which is shown in Figure 1. With regard to the descriptions contained herein, the terminology interconnected should be taken to indicate that a connection exists between the so-described elements, but that connection may be direct or indirect; that is, there may be other components or elements interstitially positioned along the connection that is so described. The drive arms 12 are pivotably mounted in bearings on the pivot shaft 4. A drive motor 13 is arranged on the base part 2 that is connected to the drive arms 12 by means of a transmission device 14. In the stapler head 3, a bending die 15 is arranged over which the staple blanks 8 are bent by the staple-former 11 into staple shape in a manner that will be clarified in the description below. Figure 1 also shows a workpiece 16 that is to be stapled, and which preferably consists of a sheaf of papers. The drive arms 12, drive motor 13 and transmission device 14 form a drive element which, in a manner that is known, drives the stapler head 3, the driver blade 10 and the staple-former 11 in an up-and-down stapling motion that is identified by the double headed arrow A.

[0017] Figure 2 shows a staple blank 8 that is bent into staple shape 17, which shape exhibits a first leg 18 and a second leg 19 which are substantially parallel, and has an intermediate crown portion 20.

[0018] Figures 3 and 4 depict in detail the staple-former 11, the bending die 15 with a staple blank 8 placed thereon, and the driver blade 10. The bending die 15 exhibits an upper support surface 21, whose direction of extension is indicated by the arrows B and C. The direction of motion of the staple-former is also indicated in this figure by a double arrow A and, as can be seen, this direction of motion is transverse to the direction of extension of the support surface B, C. The staple-former 11 comprises a plate-shaped base part 22 that has recesses 23 for the drive arms 12, but which are not shown in this Figure. The staple-former 11 further exhibits a first leg-bending pan 24, which is integrated with the base part 22 and exhibits a bending surface 25,

and a second leg-bending part 26, which is also integrated with the base part 22 and exhibits a bending surface 27. The base part 22, also referred to as a main body portion 22 of the staple forming device 11, exhibits a driver blade 10 which, as is mostly clearly seen in Figure 4, constitutes an integral part of the base part 22 of the staple-former 11. Between the leg-bending parts or portions 24 and 26 there is arranged a crown-forming part or portion 28 that exhibits a stamping surface 29 facing the bending die. The crown-forming part 28 is displaceably connected with the staple-former 11 via a first guide arrangement 30 and a second guide arrangement 31, whose directions are indicated by the double arrow D, whose direction is in agreement with the direction of the double arrow A, so that the crown-forming part can thus move in the direction indicated by the double arrow A.

[0019] On its side facing the stamping surface 29, the crown-forming part is connected with an elastic element 32, also referred to as a take-up means or device, and which is exemplarily depicted in the Figures as a leaf spring 33 bent into a hairpin shape. The leaf spring 33 is, at its opposite end 34 from the crown-forming part, fixedly connected to the base part 22. This fixed connection can be realized by welding, soldering, riveting or in any other way known to one skilled in the art that offers the necessary strength. The leaf spring 33 is inserted in a gap or hole 35 realized in the base part 22, but it will be apparent to one skilled in the art that the leaf spring can be arranged so that it extends to the left in Figure 4 rather than to the right, as is now shown, meaning that the base part need not be provided with the hole 35.

[0020] Figure 5 shows the connection of the crown-forming part 28 with the staple-former 11. As is shown, the crown-forming part 28 is in abutment with the driver blade 10. The figure further shows that the guide arrangement 30 exhibits a first sliding surface 36 arranged on the first leg-bending part 24. A second sliding surface 37 is arranged on the crown-forming part 28 and the sliding surfaces are in sliding contact with one another. The guide arrangement 31 exhibits a third sliding surface 38 on the second leg-bending part 26 and a fourth sliding surface 39 arranged on the crown-forming part 28; these sliding surfaces are also in sliding contact with one another. Because the surfaces 36 and 38 are inclined toward one another in the manner shown in Figure 5, while the surfaces 37 and 39 are similarly inclined toward one another, it is ensured that the crown-forming part 28 cannot be separated from

the driver blade 10 in the direction indicated by the arrow F, thus guarantying that the crown-forming part will be ensured a specified path of motion between the guide arrangements 30 and 31, in abutment with the driver blade 10.

[0021] The invention will now be described with reference to Figures 1-9 by describing a stapling cycle. When a workpiece 16 is to be stapled, it is placed on the staple anvil 5, at which point the stapler 1 is in its starting position, which is shown in Figure 1. The positions of the staple-former 11 and the driver blade 10 are shown in Figure 3. In this position the feed device 6 has advanced the staple band 9 onto the bending die to a position such that a staple blank 8 is situated beneath the staple-former at the same time as a blank that has been formed into staple shape 17 has been advanced to a position in front of the bending die 15, as is most clearly shown in Figures 3 and 4.

[0022] The drive device 12, 13, 14 provides an exemplary embodiment of what is referred to herein as a drive means, an arrangement which drives the stapler head 3 downward in the direction indicated by the double arrow A and into abutment with the workpiece 16, whereupon the stapler head comes into contact with the feed device 6. The staple-former 11 and the driver blade 10 remain in the positions shown in Figure 3 during this time. The drive device 12, 13, 14 thereafter continues driving the staple-former 11 downward in the direction of the double arrow A. In the course of this downward motion, the bending surfaces 24 and 26 strike the staple blank, which is bent over the bending die 14 and as is depicted in Figure 6. The driver blade simultaneously drives the staple 17 downward into the workpiece 16; but this is not shown in Figure 6. The downward motion continues thereafter through the position shown in Figure 7 and, in this position, the staple blank 8 has been bent further and the stamping surface 29 has come into contact with the crown portion 20 of the staple blank 8. The downward motion is completed once the staple-former reaches the position shown in Figure 8 and, in this position, the staple-former has been driven far enough downward that the stamping surface 29 presses the crown portion 20 of the staple blank against the support surface 21 of the bending die, whereupon the staple blank is formed into staple shape.

[0023]

In this position, the crown-forming part 28 has moved in opposition to the force from the elastic element 32 and upwards relative to the base part 2l in the direction of

the double arrow D, thus placing the elastic element 32 under tension as shown in Figure 9. In this position the driver blade 10 has driven the staple 17 completely into the work piece 16. The drive device 11, 12, 13 is thereafter reversed in a manner known to one skilled in the art, and the staple-former and stapler head resume their positions as shown in Figure 3 and Figure 1, respectively, and the tensioned elastic element returns the crown-forming part 28 to the position shown in Figure 3. During this return motion, the feed device 6 advances the staple band one step forward, whereupon a new stapling sequence can be carried out. The elastic element is designed so as to ensure that the stamping surface 29 presses the staple crown 20 against the support surface 21 with sufficient force, and that this force must be varied depending on the properties of the staple material.

[0024] In the foregoing description, the staple shape has been presented as a staple with two substantially parallel legs and an intermediate straight crown portion. It will be obvious to one skilled in the art that the straight crown portion can consist of an arched portion and that, in such a case, the bending die and stamping surface will be realized in arched form. Furthermore, the elastic element has been presented as a hairpin-shaped leaf spring, but it will also be obvious to one skilled in the art that the elastic element may consist of a helical spring whose two ends are secured to the staple-former and the crown-forming part, respectively.